



NURSERY NOTES

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FROZEN STORAGE OF BLACK SPRUCE CUTTINGS

Introduction

The juvenile rooted cutting program is an important component of Ontario's tree improvement effort. The basic production procedure for rooting juvenile cuttings has been well documented (Armson *et al.* 1980).

The parent material for cuttings is frequently kept in greenhouses so that fresh cuttings can be obtained at any time through the year. At the Swastika Tree Nursery, this involves heating a greenhouse when severely cold weather conditions prevail. Cold-storing cuttings, collected in the fall, until required for rooting would contribute to significant cost savings. Cold storage (3°C) of cuttings has proven successful with *Pinus radiata* (D. Don) (Libby and Conkle 1966) and would be advantageous with black spruce (*Picea mariana* (Mill) B.S.P.).

The purpose of the trial reported here was to determine if and under what circumstances, frozen (-3°C) black spruce cuttings would root as well as freshly excised cuttings.

Materials and Methods

Cuttings for storage were taken at room temperature (20°C) from 2-year-old black spruce seedlings lifted from a regular nursery compartment on October 22, November 6 and November 19, 1984 at Swastika Tree Nursery (48°03'N, 81°22'W). As many as ten cuttings, 6-8 cm long, were severed from each seedling with a sharp blade and packaged in a plastic bag with damp moss. Bags of 300 cuttings were then placed in cardboard boxes for storage.

Two storage treatments were used: 1/ freezing the stock immediately at -3°C and 2/ slow freezing achieved by placing the boxes in cold storage (1°C) for 2 weeks prior to freezing at -3°C.

The cuttings were planted on January 10, January 21 and February 4, 1985 in a 50/50 mixture of peat moss and vermiculite contained in Japanese FH 308 paperpots. No rooting hormones were used. Control cuttings, taken from 1-year-old seedlings grown in the greenhouse from cuttings of a clone that had been used for the last six years, were planted immediately. The stored cuttings were planted on the same day as they were removed from storage. Half of the stored cuttings had 5-10 mm removed from the base of the stem to give a fresh cut surface. The cuttings were well

watered and covered with a plastic "tent" to maintain high humidity. Extra light was provided by 1000 watt, high pressure mercury vapour lamps on an 18 hr photoperiod and temperature was maintained at 22-25°C. The cuttings were maintained for 20 weeks with watering and misting as required. At the end of this period, the cuttings were assessed for survival and rooting.

The experiment was laid out in a 4 level split plot, randomized block design with 3 planting dates, 3 cutting dates, 2 cold storage treatments, 2 re-cutting treatments and 3 replications. For example, for each planting date, all 3 cutting dates were represented and each of these treatments was assigned a cold storage and re-cutting treatment. The control was added as an extra treatment as the re-cutting treatment was not possible for the control. All data were subjected to an analysis of variance followed by Duncan's new multiple range test to detect significant differences among treatment means.

Results and Discussion

No significant differences in survival were observed among planting dates with either the re-cut cuttings or with both uncut and re-cut stems combined (Table 1). There were also no significant differences among cutting collection dates and storage treatments for the re-cut cuttings. However, in the results for original plus re-cut cuttings, the cold storage treatment before freezing on Oct. 22 had significantly less rooted cuttings than most other treatments with the exception of the directly frozen ones of Nov. 19 (Table 1).

Re-cutting the stored cuttings resulted in a 40 percent increase in survival after 20 weeks. The increase is significant at the 99.9 percent level (Table 2), and suggests that all stored cuttings should have their base re-cut prior to planting.

Significant interaction was detected between cutting date and storage method (Table 3), planting date and cutting date (Table 4) and planting date and storage method (Table 5). Freezing cuttings without a cold storage period was most beneficial for the longer storage periods while cold storage before freezing was most beneficial to stock stored for short periods. The general trends derived from these interactions raise concerns about the length of storage period for each storage treatment and the importance of collecting cuttings when fully dormant.

The control cuttings used in this trial were not from the same stock lot as the stored cuttings. However, the control cuttings represented the standard rooted cutting stock for past operational practice and therefore, can be assumed to be representative.

TABLE 1 Percent successfully rooted cuttings after 20 weeks for each planting date and each storage period. Differences among dates were tested for re-cut stems only and also for both original and re-cut stems combined.

Treatment	Number of rooted cuttings: out of 300	
	Re-cut cuttings only	Original and re-cut cuttings combined
Planting date:		
Jan. 10	59	52
Jan. 21	62	56
Feb. 4	55	47
	NS	NS
Storage treatment:		
Oct. 22, cold (1°C) before frozen	52	42 b
Oct. 22, frozen (-3°C) directly	59	52 a
Nov. 6, cold before frozen	58	54 a
Nov. 6, frozen directly	59	54 a
Nov. 19, cold before frozen	66	55 a
Nov. 19, frozen directly	60	48 ab
Control	57	57 a
	NS	*
NS Not statistically significant at 5% level		
* Significant at 5% level		
Numbers followed by the same letter are not significantly different at the 5% level		

TABLE 2 Percent rooted cuttings 20 weeks after planting directly from storage and after re-cutting the base of the cuttings (n = 300).

Cutting treatment	Percent rooted cuttings
Original	42
Re-cut	59

*** Significant at 99.9% level.

TABLE 3 Percent rooted cuttings by cutting date and storage treatment. Numbers followed by the same letter are not significantly different at the 5 percent level ($n = 300$)

Storage treatment	Cutting date		
	Oct. 22	Nov. 6	Nov. 19
Cold (1°C) before freezing	42 b	50 a	55 a
Frozen (-3°C) directly	52 a	54 a	48 ab

TABLE 4 Percent rooted cuttings by planting date and cutting date. Numbers followed by the same letter are not significantly different at the 5 percent level ($n = 300$).

Planting date	Cutting date		
	Oct. 22	Nov. 6	Nov. 19
Jan. 10	55 ab	47 b	53 ab
Jan. 21	49 ab	53 ab	52 ab
Feb. 4	38 c	56 a	50 ab

TABLE 5 Percent rooted cuttings by planting date and storage treatment. Numbers followed by the same letter are not significantly different at the 5 percent level ($n = 300$)

Storage treatment	Planting date		
	Jan. 10	Jan. 21	Feb. 4
Cold (1°C) before freezing	52 a	52 a	43 b
Frozen (-3°C) directly	52 a	51 a	53 a

Two significant factors have a bearing on the interpretation of these results. First, the 2-year-old seedlings from which cuttings were taken for storage were older than the juvenile plants from which the control cuttings were taken. Thus, the control cuttings should have had an advantage. Second, the relatively low success rates, 50-60% may be attributed to the use of dormant cutting material as opposed to the actively growing material used by Armson *et al.* (1980) where success rates of 90% were realized.

Conclusions

Cuttings taken from dormant, seedling stock from nursery compartments can be stored and successfully rooted to produce juvenile rooted cuttings. These cuttings root and survive as well as cuttings taken from parents cultured in the greenhouse for the production of fresh cuttings. However, stored cuttings should have their base re-cut prior to planting. Significant savings can be realized by not having to maintain greenhouse facilities for parent plant material while cuttings are stored.

Literature Cited

- Armson, K.A., M. Fung and W.R. Bunting., 1980. Operational rooting of black spruce cuttings. *J. Forestry* 78: 341-343.
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